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Chen

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(54) **ELECTRICAL SWITCH WITH CIRCUIT BREAKER**

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(21) Appl. No.: **10/241,190**

(22) Filed: **Sep. 11, 2002**

(65) **Prior Publication Data**

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(51) **Int. Cl.**[7] **H01H 37/52**
(52) **U.S. Cl.** **337/59**; 337/37; 337/56; 337/85
(58) **Field of Search** 337/59, 37, 77, 337/53, 55, 56, 66, 72, 85, 89, 91, 79

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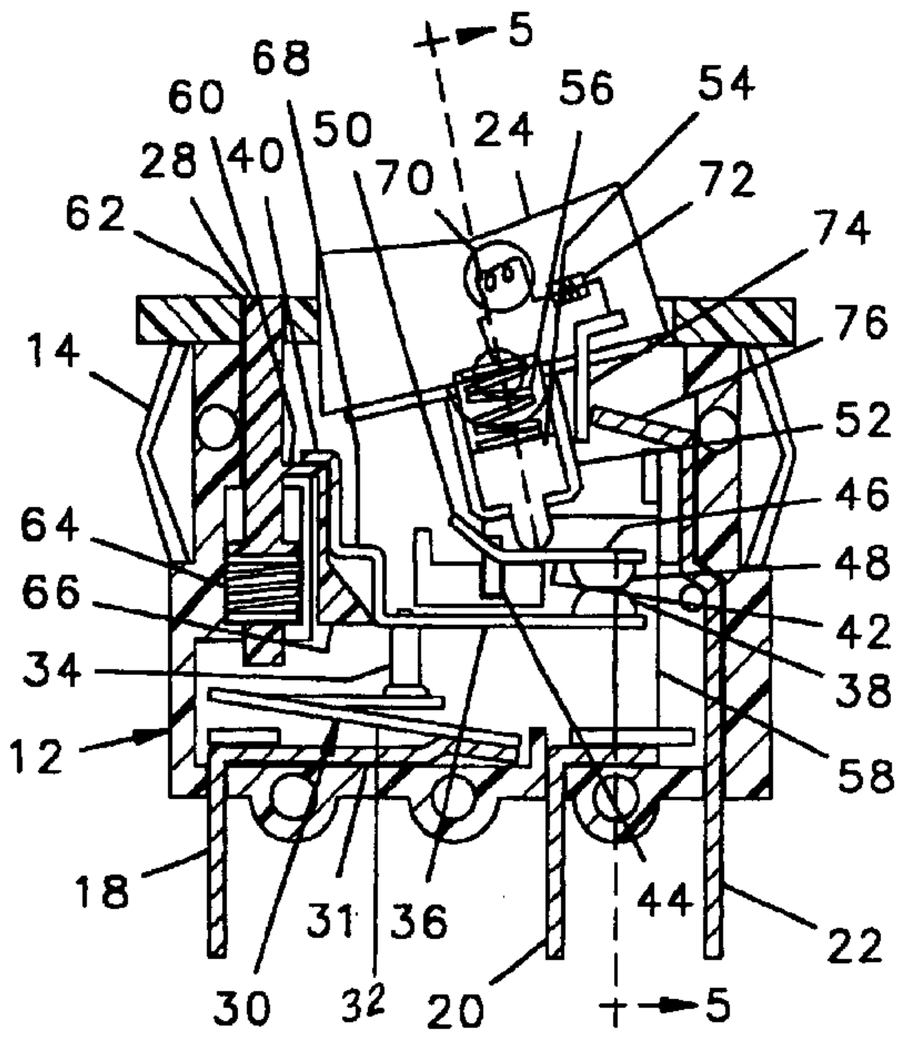
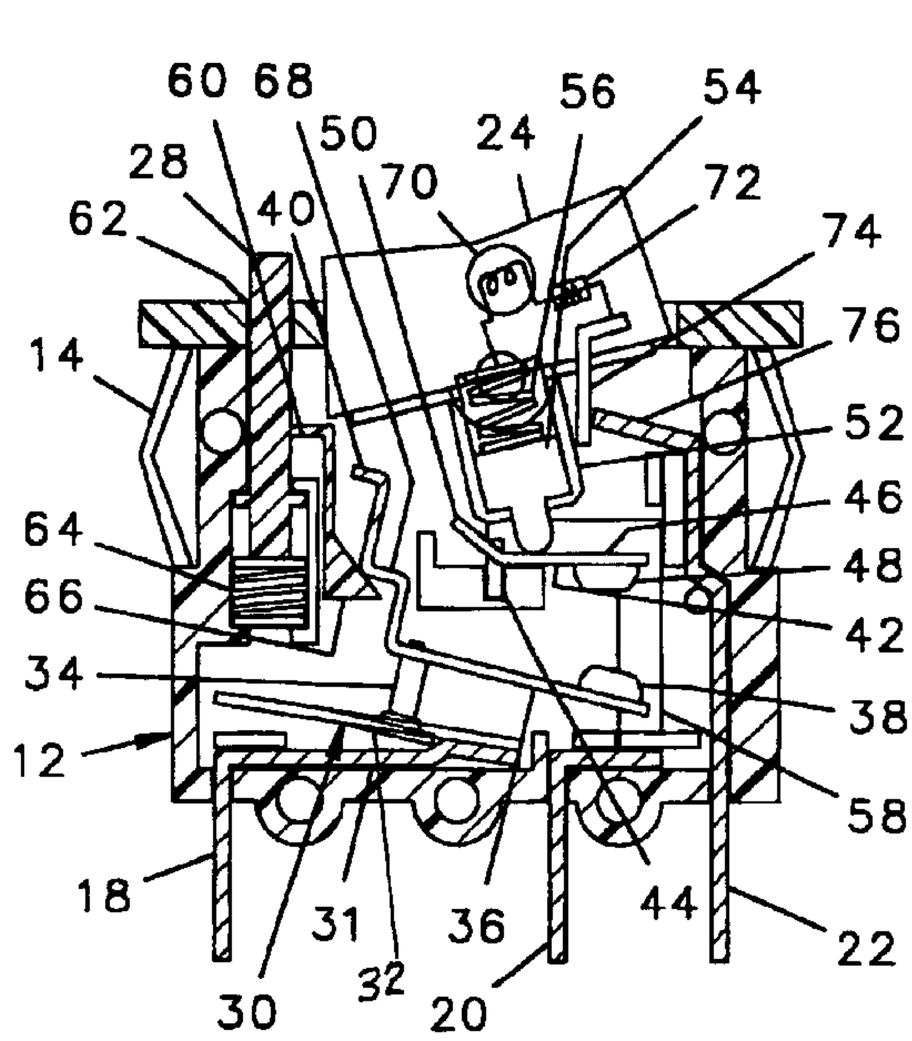
(74) *Attorney, Agent, or Firm*—Robert L. Marsh

(57) **ABSTRACT**

An electric switch having a circuit breaker includes a manually operable actuator that moves one contact between a first and a second position. A bimetal member moves another contact between a first and a second position in response to an electric current above a given threshold passing therethrough, and the movement of this contact to the second position releases a catch that retains a spring loaded indicator in its retracted position. The two contacts abut one another closing the circuit when both contacts are in their first positions. An excessive current will therefore break the circuit and release the indicator to move to the extended position. The releasable catch resets after the bimetal member has cooled and it will again retain the indicator in the retracted position when it is subsequently manually depressed.

9 Claims, 3 Drawing Sheets





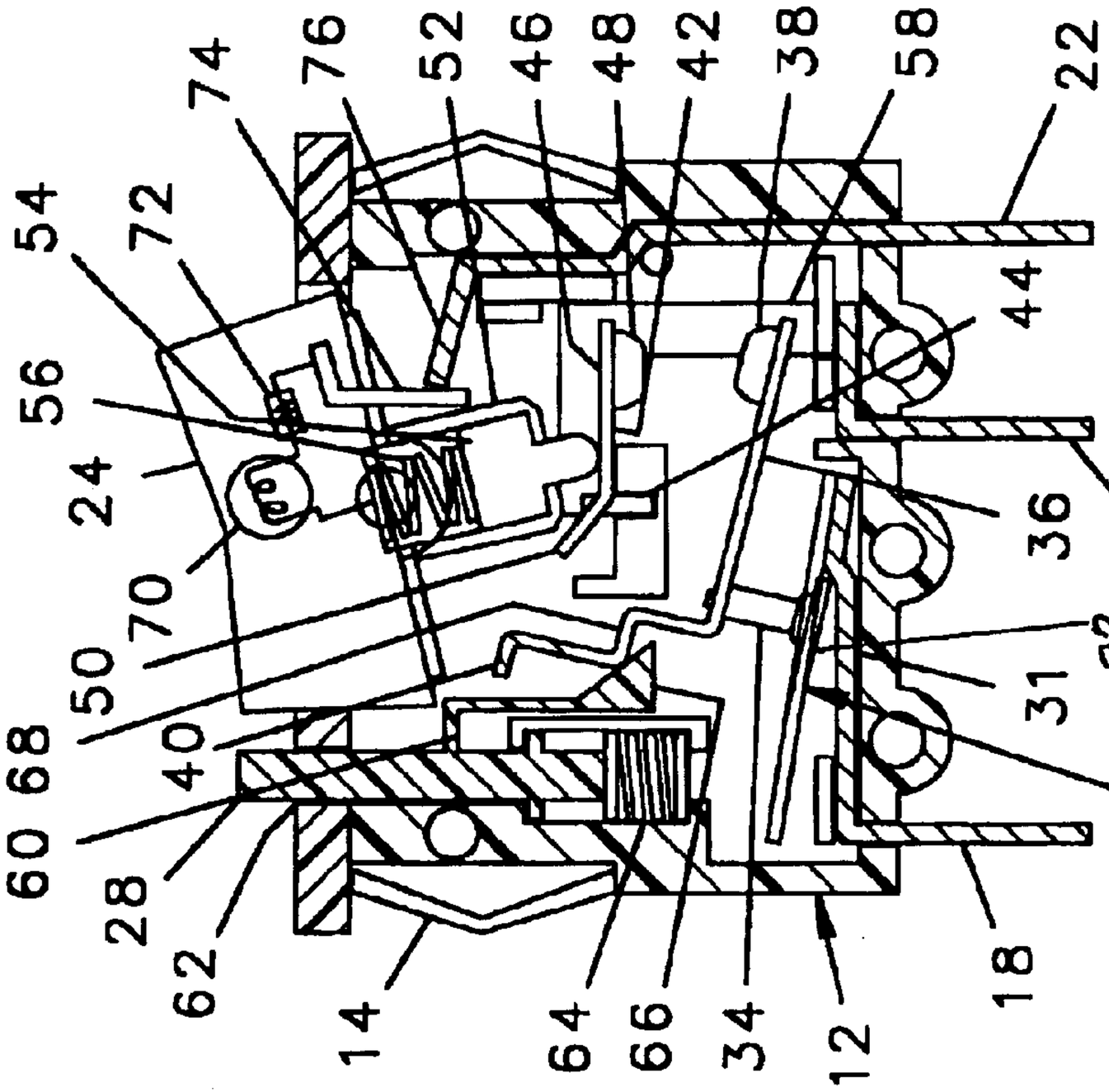

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FIG. 2

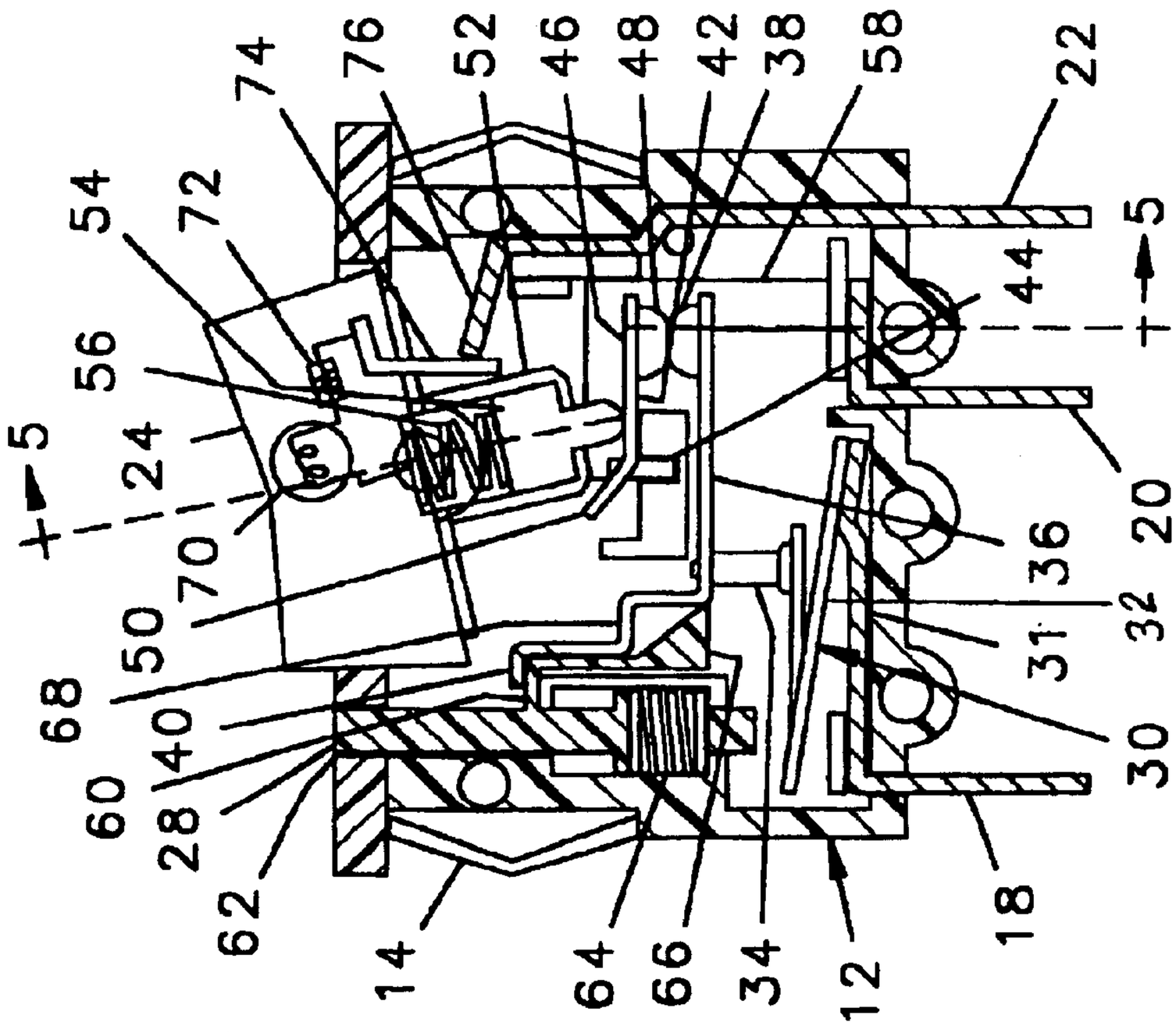
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FIG. 1

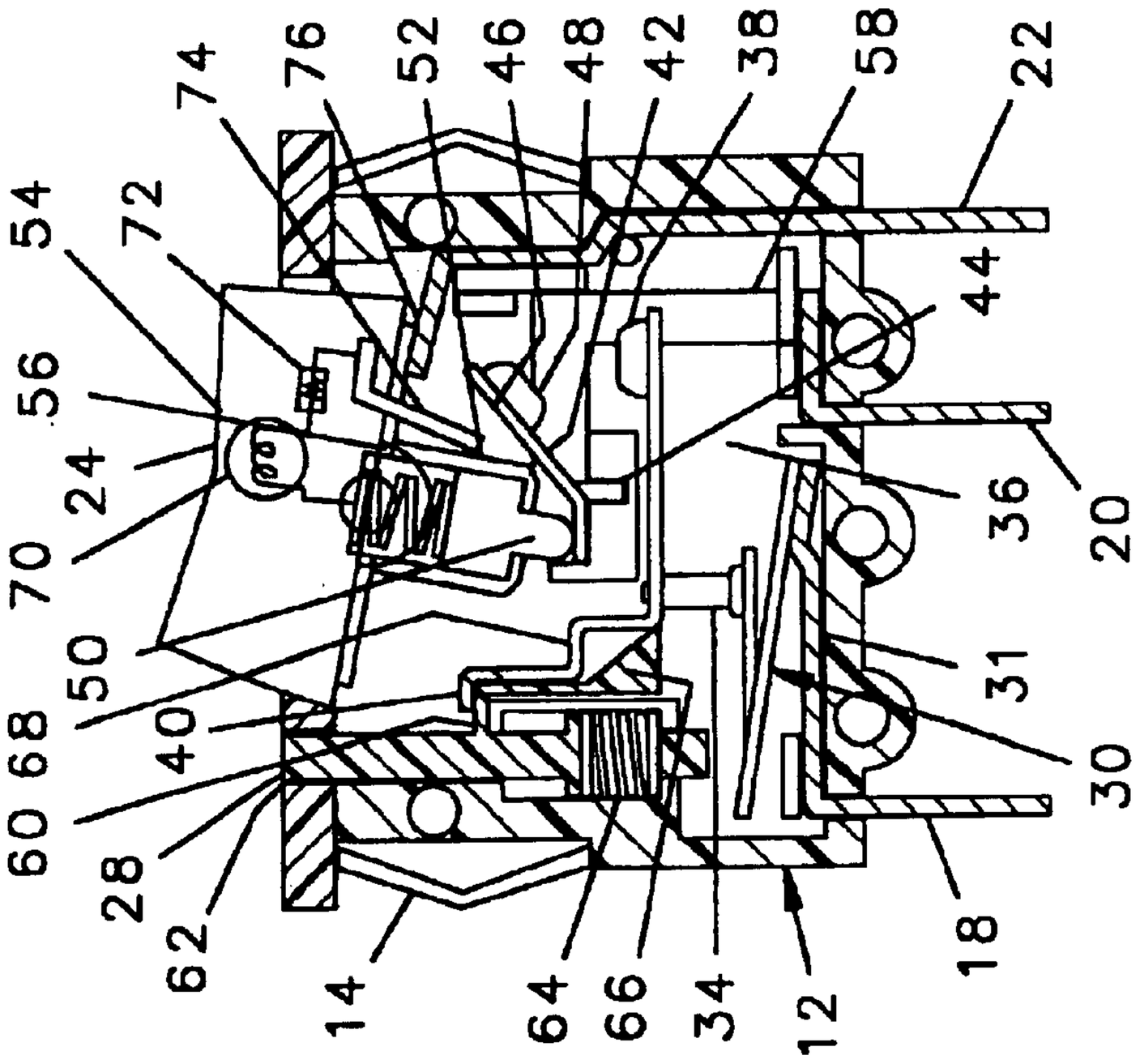
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FIG. 4

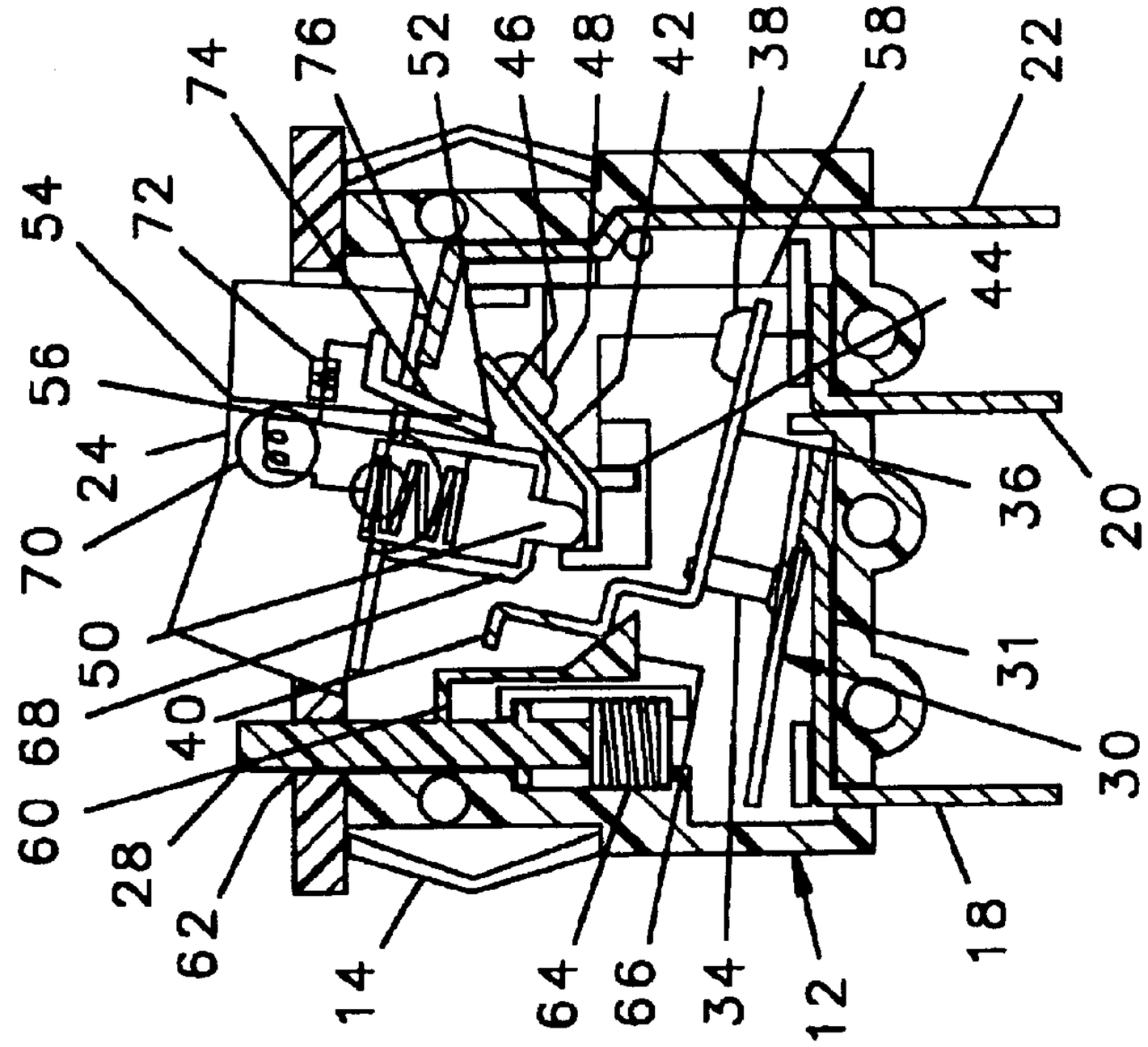
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FIG. 3

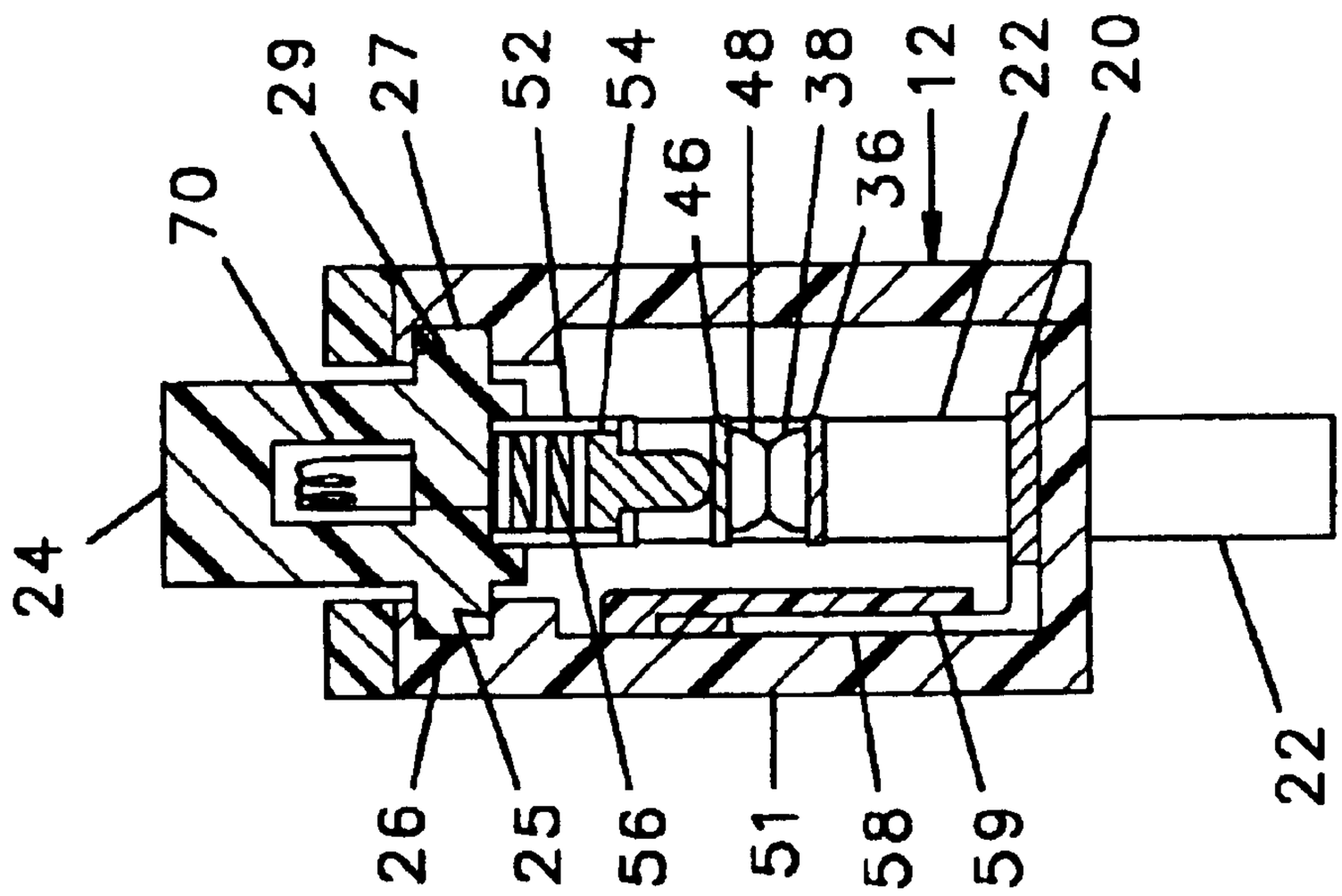


FIG. 5

ELECTRICAL SWITCH WITH CIRCUIT BREAKER

The present invention relates to electric switches of the type used to energize or de-energize an electric appliance, and in particular to an electric switch having incorporated therein a circuit breaker for de-energizing the appliance in the event of an overload.

BACKGROUND OF THE INVENTION

An electric appliance such as a vacuum cleaner or the like powered by conventional AC current is energized or de-energized by actuating a thumb-operated switched. The circuit for an appliance includes an electric motor which may become impaired by an object that obstructs the rotation of the motor. In such an event, the motor will draw an excess of current which if allowed to continue will cause damage to the circuitry of the motor or other components of the appliance. To prevent such an overload, it is desirable that the appliance include a circuit breaker which can be easily reset by the operator.

A switch incorporating a built-in circuit breaker is disclosed by Jang, U.S. Pat. No. 5,541,569. The circuit breaker of Jang includes a pivotable switch member for opening and closing the contacts of the switch, and a circuit of the switch includes a bimetal actuator. In normal operation, a contact on the bimetal actuator extends through a hole in a generally planar indicator member that is urged by a spring to an extended position. The indicator member is retained in the retracted position by the contact on the bimetal actuator that extends through the hole and abuts a second contact on the opposite side of the indicator member. In the event of an overload, the bimetal actuator causes the contact attached thereto to be retracted through the hole, thereby allowing the insulated indicator to move to the extended position. A portion of the insulated indicator then becomes wedged between the contact on the bimetal actuator and the second contact on the opposite side of the actuator thereby retaining the circuit open until the bimetal actuator is manually depressed by the operator.

An appliance such as a vacuum cleaner must be manufactured to operate on a daily basis for a number of years. During the course of the normal life of the appliance, a circuit breaker incorporated into the switch may be called into operation several hundred times. The repeated movement of the actuator erodes away the portion of the insulating material wedged between the two contacts. After a given number of uses the portion of an insulating member that has been repeatedly wedged between spring loaded contacts may become so worn away that the circuit breaker will fail to operate when called upon. It would be desirable, therefore, to provide an improved switch with an incorporated circuit breaker that does not rely upon interposing an insulating member between spring loaded contacts.

SUMMARY OF THE INVENTION

Briefly, the present invention is embodied in an electric switch for completing a circuit having a circuit breaker therein where the switch includes a manually operated actuator, a first contact, a second contact, the first contact moveable between a first position and a second position in response to an excessive current, and the second contact moveable between a first orientation and a second orientation in response to movement of the actuator. The switch includes a bimetal member and means for joining the first contact to the bimetal member wherein the first contact is moved from the first position to the second position in response to an electric current above a given threshold.

The second contact is moveable between the first orientation and the second orientation in response to movement of the actuator. In normal operation, the first contact is in an abutting relationship with the second contact when the second contact is in the first orientation and the first contact is in the first position and the contacts are spaced from one another when the first contact is in the second position, and are also spaced from one another when the second contact is in the second orientation.

The switch further includes an indicator that is moveable between an extended position indicative of a broken circuit and a retracted position indicative of a closed circuit, and means, such as a spring, for urging the indicator towards the extended position. A catch releasably retains the indicator in the retracted position. A means for releasing the catch is responsive to the movement of the first contact to the second position. The indicator also has means thereon for retaining the second contact in its second position while the indicator is in the extended position.

An operator will manually operate the actuator to turn the appliance on, thereby moving the second contact from its second orientation to its first orientation where it will abut the first contact and close the circuit. In the event of an overload in which the current exceeds the threshold as determined by the bimetal member, the bimetal member will cause movement of the first contact from its first position to its second position where it is spaced from the second contact thereby breaking the circuit. The same movement that breaks the circuit releases the spring loaded overload indicator, allowing it to be moved by the spring to the extended position. The movement of the indicator to the extended position will also lock the first contact in the second position thereby preventing the closing of the circuit after the bimetal member cools.

After an operator has checked the device and remedied the cause of the overload, the indicator can be manually depressed, returning it to the retracted position where it can again be engaged by the means for retaining. Once the indicator has been reset, the bimetal member can move the first contact back to its first position, thereby resetting the circuit breaker.

The invention further includes a first connector electrically connected to the first contact and a second contact electrically connected to the second contact. A third connector connects to a circuit for operating a lamp in the actuator, the lamp being illuminated when the actuator is in the on orientation and not illuminated when the actuator is in the off orientation. The lamp circuit includes the second connector, the third connector, and a switch operated by the actuator that is closed when the second contact is in the first orientation and opened when the second contact is in the second orientation.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the invention will be had after a reading of the following detailed description taken in conjunction with the drawings in which:

FIG. **1** is a cross-sectional view of a switch in accordance with the present invention in which the switch is closed and the circuit breaker is also closed;

FIG. **2** is a cross-sectional view of the switch of FIG. **1** in which the circuit breaker has been opened;

FIG. **3** is a cross-sectional view of the switch in FIG. **1** with the actuator opened and the circuit breaker also open;

FIG. **4** is a cross-sectional view of the switch of FIG. **1** with the actuator opened and the circuit breaker in the closed position; and

FIG. **5** is a cross-sectional view of the switch of FIG. **1** taken through line **5**—**5** thereof.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIGS. **1**–**5** a switch **10** in accordance with the present invention includes a housing **12** made of a suitable insulating material such as plastic. The switch is retained within a retaining aperture of an appliance by spring loaded members **14**, **16** on opposite sides of the housing **12** and is connected into the circuit of the appliance by a first connector **18**, a second connector **20**, and a third connector **22**. The switch **10** is opened and closed by an actuator **24** that pivots on a axis defined by pivot pins **26**, **27** rotatable in journals **25**, **29**. The switch **10** further includes a circuit breaker indicator **28** that is in a recessed position, as shown in FIGS. **1** and **4**, when the circuit of the breaker is closed, and is in an extended position, as shown in FIGS. **2** and **3**, when the circuit of the breaker is open.

The switch **10** includes a bimetal member **30** having a base portion **32** electrically connected by connector bar **31** to the first connector **18** and a displaceable portion **34** connected to a transverse first contact retainer **36**. The first contact retainer **36** has a first contact **38** on one end thereof, and a hook **40** at the opposite end thereof, the hook **40** operating as a catch to retain the indicator **28** in its retracted position as is further described below. When the current passing through the bimetal member **30** does not exceed a threshold amount and the indicator **28** is in the retracted position, the first contact retainer **36** will be in the orientation shown in FIGS. **1** and **4**.

The switch **10** further includes an elongate second contact retainer **42** pivotable about a pivot **44**. The second contact retainer **42** includes a first arm **46** at the distal end of which is a second contact **48** and a second arm **50** at an angle of about 135 degrees with respect to the first arm **46**, the axis of pivot **44** being positioned parallel to and horizontally below the axis defined by pivot pins **26**, **27** of the actuator **24**. The actuator **24** includes a cylindrical actuator tube **52** extending downwardly and radially outward from the axis defined by the pivot pins **26**, **27** and slideable within the tube is an actuator pin **54** that is urged by a spring **56** radially outward of the axis defined by pins **26**, **27** so as to press against the upper surface of the second contact retainer **42**.

The second connector retainer **42** is electrically connected through the pivot **44** and a shunt **58** extending along the back wall **51** of the housing to the second connector **20** as is best shown in FIG. **5**. To prevent arching between the shunt **68** and nearby portions of the first contact retainer **36** and insulating panel **59** may be provided against the surface of the shunt **58** opposite the back wall **51**. Movement of the actuator **24** into a first orientation, shown in FIG. **1**, while the first contact retainer **36** and first contact **38** are in the first position as shown in FIG. **1**, places the first contact **38** and second contact **48** in abutting relationship to each other, closing a circuit connecting the first connector **18** to the second connector **20**. Rotation of the actuator **24** around pivot pins **26**, **27** moves the actuator pin **54** off the first arm **46** to the second arm **50** will move the second contact **48** from its first orientation shown in FIG. **1** to a second orientation shown in FIG. **3**, thereby opening the circuit between the first connector **18** and the second connector **20**.

In the event of an overload of current moving through the circuit connecting the first connector **18** to the second connector **20**, the bimetal member **30** will become deformed displacing the displaceable portion **32** and drawing the first contact retainer **36** from the orientation shown in FIG. **1** to the orientation shown in FIG. **2** thereby moving the first contact **38** away from the second contact **48** and breaking the circuit between the first connector **18** and the second connector **20**. In addition to breaking the circuit between the first and second connectors **18**, **20**, the movement of the first connector retainer **36** from the first position shown in FIG. **1** to the second position shown in FIG. **2** will draw the hook **40** off of a shoulder **60** on the circuit breaker indicator **28**. The circuit breaker indicator **28** has an upper end which extends through an aperture **62** in the housing **12** and a lower end around which is fitted a coil spring **64** which urges the indicator **28** from the retracted position, shown in FIG. **1**, to an extended position shown in FIG. **2**, upon release of the hook **40** from the shoulder **60**. A foot **66** on the indicator **28** engages a second shoulder **68** on the first contact retainer **36** as the indicator **28** moves from the retracted position to the extended position to thereby retain the first contact retainer **36** in the second position as shown in FIG. **2**.

In the event of an overload in the circuit connecting the first connector **18** to the second connector **20**, the bimetal member **30** will cause the first contact **38** to move away from the second contact **48** while simultaneously releasing the indicator **28** to be urged to the extended position by the coil spring **64**. Movement of the indicator to the extended position by the coil spring **64** will further result in the first contact retainer **36** being locked by the foot **66** in the second position as shown in FIG. **3**.

After the bimetal member **30** has been allowed to cool, the indicator **28** can be manually depressed. Depressing the indicator **28** move the foot **66** away from the second shoulder **68** and allows the first contact retainer **36** to return to the position shown in FIG. **1** where the hook **40** will again engage the shoulder **60** on the indicator **28**. The engagement of the hook **40**. on the shoulder **60** will retain the indicator **28** in the retracted position with the coil spring **64** compressed until an excessive current again passes through the bimetal member **30**.

The switch **10** further includes a lamp **70** inside the actuator **24** which illuminates the actuator **24** when it is in the "on" position. One connector from the lamp **70** is connected through the coil spring **56**, through the electrically conductive actuator pin **54**, the second contact retainer **42**, the bimetal actuator **30** and the first connector **18**. The opposite connector of the lamp **70** is connected through a resistor **72** to one contact **74** of a secondary switch. The second contact **76** of the secondary switch is connected by connecting bus **77** to the third connector **22**. Movement of the actuator to the "on" position wherein the second contact **48** is in the first orientation moves contact **74** against contact **76** closing the secondary switch as shown in FIGS. **2** and **3**. Moving the activator to the "off" position, wherein the second contact **48** is in the second orientation moves contact **74** away from contact **76** opening the secondary switch, as shown in FIGS. **1** and **4**. The lamp **70** will therefore be illuminated when the actuator **24** is rotated to the "on" position, as shown in FIGS. **1** and **4** and will not be illuminated when the actuator **24** is pivoted to the "off" position as shown in FIGS. **2** and **3**. If the actuator is in the "on" position but the bimetal actuator has been overloaded, as shown in FIG. **2**, the lamp will again not be illuminated because power to the lamp **70** must flow from the first contact **18**, through the bimetal actuator **30**, the contacts **38**, **48** and the pin **54**. Opening the contacts **38**, **48** therefor breaks the circuit to the lamp **70**.

There has therefore been described a switch for electrically switching on and off an appliance where the switch has incorporated therein a circuit breaker for breaking the circuit in the event of an overload of power drawn by the appliance. There is further provided a lamp that is illuminated when the actuator **24** is switched to the "on" position and the bimetal actuator has not been overloaded, and is not illuminated when either (1) the actuator **24** is switched to the "off" position, or (2) the bimetal actuator has been overloaded and the indicator has not been reset.

While the present invention has been described with respect to a single embodiment, it will be appreciated that many modifications and variations may be made without departing from the true spirit and scope of the invention. It is, therefore, the intent of the appended claims to cover all the modifications and variations that fall within the spirit and scope of the invention.

What is claimed is:

1. An electric switch for completing a circuit and having a circuit breaker, said electric switch comprising

a manually operable actuator,

a first contact,

a second contact,

said second contact moveable between a first orientation and a second orientation in response to movement of said actuator,

a bimetal member having a displaceable portion,

a retainer on said displaceable portion,

said first contact on said retainer wherein said first contact is moveable from a first position to a second position in response to an electric current above a given threshold passing through said bimetal member,

a catch on said retainer spaced from said first contact,

an indicator moveable between a position indicative of a broken circuit and a position indicative of a closed circuit,

means for urging said indicator toward said position indicative of an opened circuit, and

said catch releasably retaining said indicator in said position indicative of a closed circuit.

2. The electric switch of claim **1** and further comprising

said actuator having an "on" orientation and an "off" orientation,

said second contact moveable between said first orientation and said second orientation in response to movement of said actuator from said "on" orientation to said "off" orientation.

3. The electric switch of claim **2** wherein said first contact is abutting said second contact when said second contact is in said first orientation and said first contact is in said first position.

4. The electric switch of claim **3** and further comprising

a first connector electrically connected to said first contact,

a second connector electrically connected to said second contact.

5. The electric switch of claim **4** and further comprising

a third connector,

a lamp in said actuator, and

a lamp circuit including a secondary switch, said third connector, and one of said first and said second connectors, wherein said secondary switch is opened when said actuator is in said "off" orientation and closed when said actuator is in said "on" orientation.

6. An electric switch for completing a circuit and having a circuit breaker, said electric switch comprising

a manually operable actuator moveable from an "on" position to an "off" position,

a first contact moveable between a first position and a second position,

a second contact,

said second contact moveable between a first orientation and a second orientation in response to movement of said actuator from said "on" position to said "off" position,

a bimetal member having a displaceable portion,

means for moving said first contact from said first position to said second position in response to an electric current above a given threshold passing through said bimetal member wherein said first contact is abutting said second contact when said second contact is in said first orientation and said first contact is in said first position and spaced from said second contact when said first contact is in said second position and said second contact is in said first orientation and said manually operated actuator remains in said on position.

7. An electric switch for completing a circuit and having a circuit breaker, said electric switch comprising

a manually operable actuator,

a first contact moveable between a first position and a second position,

a second contact,

said second contact moveable between a first orientation and a second orientation in response to movement of said actuator,

a bimetal member having a displaceable portion,

means for moving said first contact from a first position to a second position in response to an electric current above a given threshold passing through said bimetal member wherein said first contact is abutting said second contact when said second contact is in said first orientation and said first contact is in said first position and spaced from said second contact when said first contact is in said second position,

an indicator moveable between an extended position indicative of a broken circuit and a retracted position indicative of a closed circuit,

means for urging said indicator toward said extended position,

a catch for releasably retaining said indicator in said retracted position,

means on said indicator for retaining said second contact in said second position while said indicator is in said extended position, and

means for releasing said catch in response to movement of said first contact to said second position.

8. The electric switch of claim **7** and further comprising

a first connector electrically connected to said first contact,

a second connector electrically connected to said second contact,

a third connector,

a lamp in said actuator,

a lamp circuit including a secondary switch, said third connector, and one of said first and said second connectors wherein said secondary switch is opened on movement of said actuator causing said second contact

to move to said second orientation and is closed on movement of said actuator causing said second contact to move to said first orientation.

9. An electric switch for completing a circuit and having a circuit breaker, said electric switch comprising

a manually operable actuator moveable between an "on" orientation and an "off" orientation,

a first connector,

a bimetal member having a base and a displaceable portion,

said base of said bimetal member connected to said first connector,

a first contact connected to said displaceable portion wherein said first contact is moveable between a first position and a second position in response to the displacement of said of said displaceable portion,

a second contact,

said second contact moveable between a first orientation and a second orientation in response to movement of said actuator from said "on" orientation to said "off" orientation,

a second connector connected to said second contact,

said first contact abutting said second contact when said second contact is in said first orientation and said first contact is in said first position and spaced from said second contact when said first contact is in said second position,

an indicator moveable between an extended position indicative of a broken circuit and a retracted position indicative of a closed circuit,

means for urging said indicator toward said extended position,

a catch attached to said displaceable portion,

said catch for retaining said indicator in said retracted position and for releasing said indicator for movement to said extended position upon movement of said displaceable portion, and

means on said indicator for retaining said second contact in said second position while said indicator is in said extended position.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,741,157 B2
DATED : May 25, 2004
INVENTOR(S) : Jack Chen

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

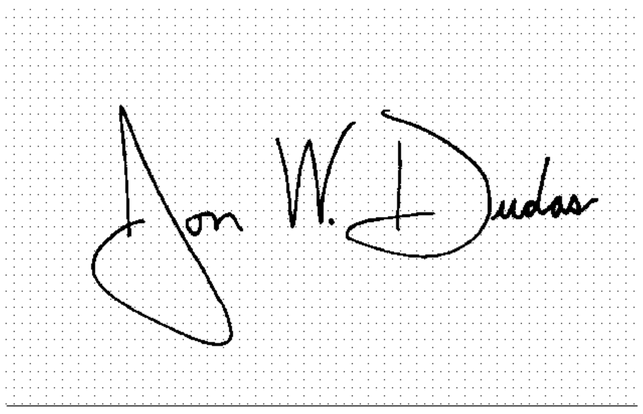
Column 3,
Line 52, after "retainer 36" delete "and" substitute -- an --.

Column 6,
Line 23, after "said," delete "on" and substitute -- on --.

Column 7,
Line 17, after "displacement" delete the first recitation of "of said".

Signed and Sealed this

Eleventh Day of January, 2005



JON W. DUDAS
Director of the United States Patent and Trademark Office